DOCUMENT RESUME

ED 452 094 SE 064 722

AUTHOR	Hammrich, Penny L.; Richardson, Greer M.; Green, Tina Sloan; Livingston, Beverly
TITLE	Sisters in Science: Using Sports as a Vehicle for Science Learning.
PUB DATE	2001-04-00
NOTE	18p.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Academic Achievement; *Athletics; Educational Change; Elementary Education; *Females; *Learning Activities; Mathematics Education; Middle Schools; *Minority Groups; Science Instruction; Science Programs; Scientific Principles; Self Esteem; Urban Areas
IDENTIFIERS	Diversity (Groups); Systemic Educational Reform

ABSTRACT

This paper describes a project for upper elementary and middle school minority girl students called the Sisters in Sport Science (SISS). The SISS program addresses the needs of urban girls in gaining access to equal education in science and mathematics by using athletics as a vehicle for learning. The program provides a non-competitive and non-threatening learning environment. Fencing, tennis, golf, and basketball are the sports targeted for learning activities. (Contains 14 references.) (YDS)

Reproductions supplied by EDRS are the best that can be made
from the original document.

SE

SISTERS IN SCIENCE: USING SPORTS AS A VEHICLE FOR SCIENCE LEARNING

ED 452 094

Penny L. Hammrich, Temple University
Greer M. Richardson, LaSalle University
Tina Sloan Green, Temple University
Beverly Livingston, Temple University

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY
P. Hammrich
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Introduction

The previous decade has witnessed many voices calling for reform in the teaching of science and mathematics. The federal government identified six National Education Goals that boasted the United States would be first in the world in science and mathematics by the year 2000 (Culotta, 1990; Vinovski, 1996); and it is presently launching a series of exams in reading and mathematics to improve student achievement and increase the status of American students in an ever-increasing global marketplace (Baker, 1997). Furthermore, policymakers, scientists and mathematicians have focused on change to develop the scientific and mathematical knowledge that will produce a healthy economy and maintain a meaningful democracy (Tate, 1994). Reform, however, does not occur overnight. Systemic reform must remain on the national agenda if we as a nation hope to attain the goals posed by the federal government and such professional organizations as the National Council of Teachers of Mathematics and the American Association for the Advancement of Science.

The conditions of many urban schools and the communities to which they belong are appalling (Apple, 1992; Kozol, 1991). Lifelong learning in science, mathematics and technology is impossible to realize when many urban students have no access to the Internet and fewer textbooks, manipulatives and science equipment than suburban students. In particular, minority students (i.e., African-Americans, Latinos and women) and students from low socioeconomic backgrounds confront great structural challenges in choosing and performing well in science,

SE 054 752

BEST COPY AVAILABLE

mathematics and technology related fields (Hammrich, 1997; Hanson, 1996; Oakes, 1990). Innovative programs must provide access to the newest and most advanced tools in science, mathematics and technology. Furthermore, awareness of cultural differences, including learning style, need to be an integral part of the format, organization and content of an effective program. A current view of how individuals receive and process information proposed several (rather than just one) independent forms of information processing, including logical-mathematics, linguistic, musical, spatial, bodily kinesthetic, interpersonal and intrapersonal (Gardner, 1993). Because individuals may differ in their specific profile of "intelligence's," education needs to be diverse in its offerings, both in terms of content and format of instruction, in order to be effective (Nieto, 1996).

The AAUW (1998) publication "Gender Gap: Where School Still Fail Our Children" suggests that "Sports participation in general is linked not just to higher academic achievement but also to better physical and mental health and greater leadership capacity...Like classroom interactions, sports can either challenge or reinforce stereotypes about girls' and boys roles." (p. 74). and "...Unique capacity of school sports to prompt students and adults to question their own assumptions about gender (p.77). Other research supports the positive relationship that exists between participation in extracurricular activities and school success (Lamborn et al.).

The Sisters in Sport Science (SISS) program supports and furthers this vision by providing mathematical and scientific concepts through the vehicle of sports. In doing so, the program is successfully reaching students in a variety of ways and strengthening the education of students in science and mathematics by creating an unique and diverse pedagogical atmosphere.

Girls and minority youth in the late elementary through middle school years tend to struggle with self-esteem, physical fitness, skill development, goal setting, and problem solving.

Sports are one ideal mechanism to reach girls and minority youth during these uncertain years in which they explore their self-identities. Research links physical activity for girls to higher self-esteem, positive body image, and lifelong health (AAUW, 1998, p. 20) and "... involvement in activities valued by school (athletics and the arts) leads to higher self-esteem, positive attitudes toward school, and less self-destructive behavior."(AAUW, 1998, p.77). By using sports as a vehicle for learning scientific principles, the SISS program is responding to the national call for creating innovative programs that provide access to the latest strategies in promoting science literacy.

Program Description

Rationale

SISS addresses the need for urban girls to gain equitable access to science and mathematics education by using sports as a vehicle for learning. Specifically this need is based on the rising public concern over the equity gap in science and mathematics, recognition of the significant impact intervention programs targeting urban girls have on school success, and the call for systemic educational reforms that recognize the limits minority girls face in post secondary education and employment opportunities.

SISS addresses the diversity inherent in learning by using sports as the context through which scientific and mathematical principles can be explored. Through the vehicle of sports not only are girls learning the underlying principles of science and mathematics embedded in the mechanics of performing a sport, but also, they are learning the scientific principles in an atmosphere that embraces the psycho-social-emotional connection to learning. For instance, each day girls learn how to ride a bike, throw a ball, and/or jump rope. They learn these activities in an environment that is non-competitive and non-threatening academically. What they are not

aware of is the scientific and mathematical principles laden in performing these activities. In the classroom girls learn these scientific and mathematical principles in a context which is foreign to their everyday experiences. They learn about the trajectory of a golf ball without connecting this principle with the actual of practice of hitting a golf ball. What is unique about the concept of SISS is that the academic and the everyday experiences of girls are bridged. To this end, the teaching and learning process embraces not only the academic principles of learning but captures the psycho-social-emotion process of learning. In doing so the context of learning science and mathematics is enriched for the girls.

While programs that address the equitable achievement for all students in science and mathematics are not new, using sports as a vehicle through which science and mathematics interest and achievement can be attained is unique. This approach bridges the application of concepts embedded in science and mathematics to the mechanics of performing a sport. Sports provide a unique and innovative approach to reaching girls in a friendly atmosphere while learning concepts usually too abstract for them to grasp due to their limited experience and exposure. By using sports as a vehicle for learning scientific and mathematical principles, the SISS program is responding to the national call for creating innovative programs that provide access to the latest strategies in promoting science literacy.

Goals and Objectives

The overall goal of the proposed project is to design, implement, evaluate, and disseminate a field-based program aimed at fostering the resilience of minority girls, grades 6th – 8th, in science and mathematics through the vehicle of sports. The project builds upon the two-year intervention of the *Sisters in Science* program and provides second level of intervention for

a sustained longitudinal look at how girls are achieving in math and science. The project builds upon the existing SEM curriculum through specific activities and learning methods shown to increase minority girls' interest and achievement in SEM through the vehicle of sports. The following objectives are being pursued.

Objective 1: To increase science and mathematics achievement of minority middle school girls through the vehicle of sport.

Objective 2: To increase the number of effective teachers and coaches who will co-facilitate sports as an avenue for science and mathematics learning.

Objective 3: To enhance the self identities of minority girls in the areas of self esteem, physical fitness, skill development, goal setting, and problem solving through the vehicle of sport and science and mathematics.

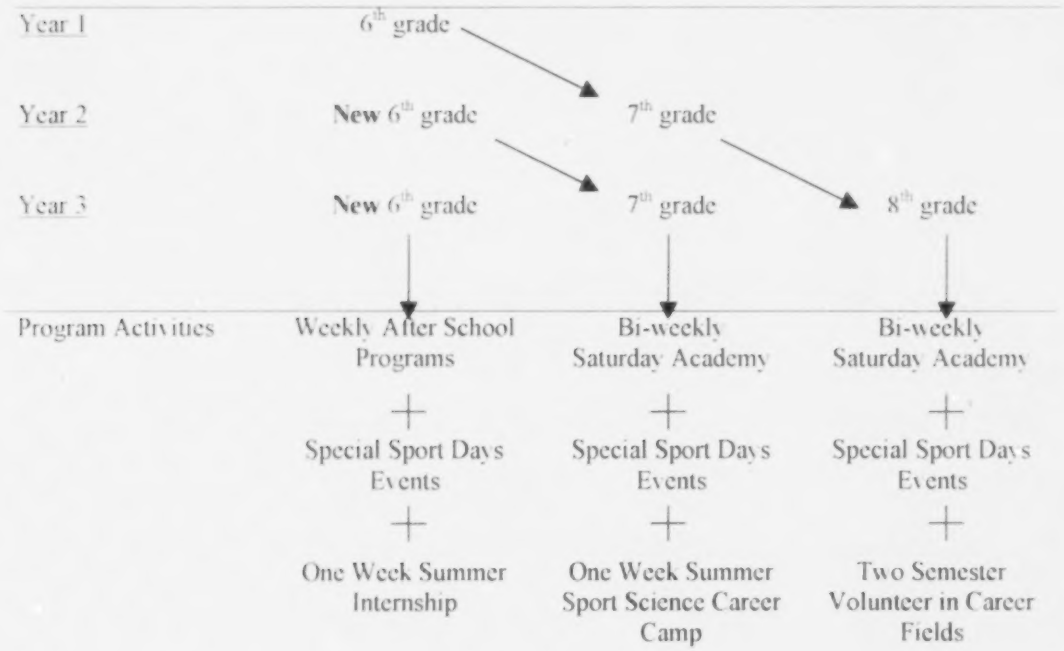
Objective 4: To increase families and caregivers knowledge of sports as an effective way to foster science and mathematics achievement.

Objective 5: To increase minority girls careers awareness of science, mathematics and sport related fields.

Program Components. The proposed project is designed as a three-year intervention involving middle school minority girls from six middle schools over a three-year period (see Figure 1). The focus is on providing a longitudinal intervention at the middles school level that expands on the efforts of the *Sisters in Science* program, which targets the elementary level. This three-year intervention is devoted to developing, implementing, and expanding program activities that have been piloted in the *Sisters in Science* program and longitudinally tracking girls through the second level of intervention. Through the utilization of minority athletes, middle school teachers, university students, as well as summer internships, career camps, academic internships,

and family involvement the project will have a direct impact on girls, parents, and the SEM curriculum by focusing on sports as a vehicle for science and mathematics learning. All sport science activities are matched to the Philadelphia middle school science and mathematics standards. One of the outcomes of the program will be the expansion of such concepts as force, motion, geometry, and mechanics. By enhancing the capacity to promote science and mathematics literacy through the utilization of sports, the project supplements other systemic at Temple University and the School District (Sisters In Science, Daughters with Disabilities, Collaboration for the Excellence in Teacher Preparation, Alliance for Minority Participation in Science and Mathematics, and the Urban Systemic Initiative). The project will rely heavily on incorporating existing sports activities developed by the Black Women in Sport Foundation and the sport science activities developed in the Sisters in Science program.

Figure 1. Three Year Intervention Model



The project builds upon the existing SEM curriculum through specific activities and learning methods shown to increase minority girls' interest and achievement in SEM through the vehicle of sports. The SISS project includes the development of a supplemental science and mathematics curriculum through the utilization of sports. The curriculum enhancement is standards based and has an equity focus. Each activity features a specific sport and the science and mathematics utilized in performing the sport and features an athlete from the sport and a scientist or mathematician. The entire three-year supplemental curriculum includes 10 sports, 40 science and mathematics standards driven activities that feature a sport as the mechanism through which the science and mathematics is learned. The ten sports featured in the curriculum program include: (1) five team sports – volleyball, basketball, soccer, hockey, and softball; and (2) five individual sports - fencing, golf, tennis, track (running), track (throwing). The project will achieve the goals and objectives through 5 components: (1) after school programs; (2) Saturday academies; (3) special sport day events; (4) academic and summer internships; and (5) career connections.

In **Year 01,** the first level of intervention will include the targeted 180 6th grade girls from the six schools. The following sports are targeted: fencing, tennis, golf, and basketball. The girls are participating in the following activities during year one.

After school programs: The after school programs are conducted at each of the six school sights one day a week for 20 weeks from 3:00 PM to 5:00 PM. Ten weeks during the fall and ten weeks during the spring. One graduate student and one teacher from each school act as co-facilitators of the curriculum during the after school sessions. Undergraduate education students and minority athletes support the co-facilitators. Since there are four sports that are featured each sport lasts five weeks. This provides ample time for the girls to grasp both the

sport and the science and mathematics principles applied in performing the sport. The after school program has the minority girls participate for one hour on sport mechanics and one hour on the science and mathematics principles in performing the sport.

Special sport day events: There are four special sport day events. Each sport day will are conducted on a Saturday following the 5 week rotation of the sport conducted in the after school program. Families join their daughters in participating in the sport. The girls prepare a short presentation of the science and mathematics principles applied in performing the sport. Families are given a *Sport Science Poster* outlining the sport and the corresponding science and mathematics principles.

Summer Internships: On a competitive basis 20 percent (45-50) of the minority girls are awarded summer internships. These internships are for one week in length and are used to shadow someone in a career path that interests her. Such possible internships include: sport therapy, exercise physiology, coaching, biomechanical engineer, exercise scientist, althetic trainer. The girls receive service credit from their school for successfully participating in the internships. Girls are expected to keep a reflective journal of their experience and write a report.

In **Year 02,** the second level of intervention will include the targeted 180 6th grade girls in **Year 01** now 7th grade girls at the six schools. Also in **Year 02** a new set of targeted 180 6th grade girls will start the first level of intervention mentioned above. The following sports will be targeted in the second level of intervention at the 7th grade: volleyball, soccer, track (running). The girls will participate in the following activities during **Year 02**.

Saturday academy programs: The Saturday academy programs will be conducted at Temple University bi-weekly for 20 weeks from 10:00 AM to 2:00 PM. Ten weeks during the fall and ten weeks during the spring. Two graduate students and one teacher from each school

will act as co-facilitators of the curriculum during the Saturday academy sessions. Undergraduate education students and minority athletes will support the co-facilitators. Since there are three sports that will be featured each sport will last approximately 5-8 weeks. This will provide ample time for the girls to grasp both the sport and the science and mathematics principles applied in performing the sport. The Saturday academy program will have the minority girls participate for one hour on sport mechanics and three hours on the science and mathematics principles in performing the sport. The girls will spend more and more time on the science and mathematics during **Year 02** of the intervention. Another highlight will be the inclusion of technology in simulating the science of the sport through computer simulations. We will partner with the College of Technology and Engineering at Temple University to help with the inclusion of technology. We have successfully worked jointly with them during the *Sisters in Science* program.

Special sport day events: There will be three special sport day events. Each sport day will be conducted on a Saturday following the 5-8 week rotation of the sport conducted in the Saturday academy program. Families will join their daughters in participating in the sport. The students will prepare a short presentation of the science and mathematics principles applied in performing the sport. Families will be given a *Sport Science Poster* outlining the sport and the corresponding science/mathematics principles.

Summer Sport Science Career Camp: On a competitive basis a 20 percent (45-50) of the minority girls will be awarded summer internships to participate in the sport science career camp. The career camp will focus on revisiting the science and mathematics of the sports conducted so far and a more intensive exploration of the career connection. The girls will spend the week conducting extensive research on the science and mathematics behind one of the sports

and conducting an experiment that both focuses on a career as well as on a current issue in science and mathematics. (For example in track – running. A topic could be - How has the speed of an athlete change exponentially over the history of time? Some girls may choose to look at the bio-mechanics embedded in the issue while other girls may pursue the science of technology that could have led to the increase in speed.) The girls will be partnered up electronically with a scientist in the field of her choice. They will conduct an experiment to test their hypothesis. During the last day the girls will present their results. The girls will be partnered up with Temple and LaSalle University students during the camp to help the girls with their research projects on a daily basis. The girls will receive service credit from their school for successfully participating in the camp.

In **Year 03,** the third level of intervention will include the targeted 180 6th grade girls in **Year 01** now 8th grade girls at the six schools. Also in **Year 03** a new set of targeted 180 6th grade girls will start the first level of intervention mentioned above and the second level of intervention will entail the **Year 02'** 6th grade girls now 7th grade girls. The following sports will be targeted in the third level of intervention at the 8th grade: softball, hockey, track –throwing. The girls will participate in the following activities during **Year 03**.

Saturday academy programs: The Saturday academy programs will be conducted at Temple University bi-weekly for 20 weeks from 10:00 AM to 2:00 PM. Ten weeks during the fall and ten weeks during the spring. Two graduate students and one teacher from each school will act as co-facilitators of the curriculum during the Saturday academy sessions. Undergraduate education students and minority athletes will support the co-facilitators. Since there are three sports that will be featured each sport will last approximately 5-8 weeks. This will provide ample time for the students to grasp both the sport and the science and mathematics

principles applied in performing the sport. The Saturday academy program will have the minority youth participate for one hour on sport mechanics and three hours on the science and mathematics principles in performing the sport. The girls will spend more and more time on the science and mathematics during **Year 03** of the intervention. Another highlight will be the inclusion of technology in simulating the science of the sport through computer simulations.

Special sport day events. There will be three special sport day events. Each sport day will be conducted on a Saturday following the 5-8 week rotation of the sport conducted in the Saturday academy program. Families will join their daughters in participating in the sport. The students will prepare a short presentation of the science and mathematics principles applied in performing the sport. Families will be given a *Sport Science Poster* outlining the sport and the corresponding science and mathematics principles.

Academic Internships in Career Fields. On a competitive basis a 20 percent (45-50) of the minority girls will be awarded academic internships to participate in year long sport science career projects. The career projects will have the girl's partner up with a person in a field they wish to pursue. The girls will design a research project in consultation with the person in the field. The will visit the person in the field once a month while simultaneously having contact with these individuals on-line. The girls will spend the year designing and conducting their research project. The girls' projects will be showcased at the end of the year at a special Sport Science Career Night presentation. For example, a girl my want to pursue a research project in the area of sports medicine. A topic could include the level of activity pursuant to a injury to the anterior cruciat ligament on the range of movement achieved as a result of different types of corrective

surgery or other options available. The girls will receive service credit from their school for successfully participating in the internship.

Program Evaluation

Method

The Sport Science program is a three-year intervention involving 540 middle school minority girls from six middle schools over a three-year period, teachers, college students, minority athletes, and mentors. The focus is on providing a longitudinal intervention at the middle school level that expands on the efforts of the *Sisters in Science* program, which targets the elementary school. The six middle schools participating in the SISS program are the feeder schools from the *Sisters in Science* schools.

The assessment plan will have two components: one, which is essentially an outcome or impact assessment, and the other an analysis of the processes undertaken before and during program implementation. The former will measure quantifiable results while the latter will provide a qualitative gauge of service delivery.

With regard to the outcome assessment, this will have two parts. First, all 540 youths (or the number who complete the program) that participate in the program will be assessed at the program's end to determine if they acquired the specific knowledge and information that was imparted.

There will also be a quasi-experimental portion to the outcome assessment. Forty youths (out of the 240) will be randomly selected from the targeted schools by Temple to participate in the program. These 40 will constitute the experimental group. The remaining 200 will self select into the program or be chosen by teachers or school officials. Temple will randomly select another 40 (above the 240) to service as the control group. This group of 40 will not receive

program services. The random selection of 80 youths should limit the impact of any alternative or intervening variables. Students from both experimental and control groups will, in all probability, be from similar socioeconomic backgrounds, since they will be chosen from the same schools and neighborhoods.

At the end of the program the 80 youths will be assessed and compared with respect to their self-esteem, behavior in school and their academic performance in science and mathematics. Report cards and Stanford Nine scores will be used for behaviors, science and mathematics comparisons. The Student self-concept Scale will be administered when evaluating the control and experimental groups for changes in self-esteem. The results from both groups will be averaged and formatted in tables. Associations between independent (program activities) and dependent (grades, behaviors and self-esteem) variables will then be deduced and analyzed.

The second component of the evaluation plan will be the process aspect. It will focus on The program work plan and will assess the degree to which benchmarks and timelines were met. Issues such as recruitment parent participation and participant satisfaction will be reviewed. A narrative report, including the results of participant surveys, interviews and focus groups will be composed to give a comprehensive exposure of the program's performance.

Results

Since the SISS program is in its first full year of implementation the results are forthcoming. However, preliminary findings to date show that the girls in the program have increased their interest and achievement in science and mathematics and the relevance of science and math to the sports in which they have participated in so for within the program. For example, of the 20 students who were interviewed during the first Special Event at Temple University's campus, all indicated that they were having

fun, were enjoying the program, and were able to cite at least on fact about tennis that they had not known prior to participating in the program. Eighty percent (16 of the 20) of the respondents could remember scientific facts that were learned during the program sessions. For example, respondents mentioned facts about angles, measurements, reflection, and awareness of careers in science. Seventy percent 914 of the 20) respondents felt that the SISS sessions reinforced the science instruction that they had received in school from their teachers. One hundred percent (20 0f the 20) respondents felt that playing tennis was what they liked most about the program. The girls in the program have an increased understanding of science and math learning and see the relevance of science and math to their everyday lives. Informal conversations also show an increase in girls' awareness of careers in science and sports.

Implications

While programs that address the equitable achievement for all students in science and mathematics are not new, using sports as a vehicle through which science and mathematics interest and achievement can be attained is unique. This approach bridges the application of concepts embedded in science and mathematics to the mechanics of performing a sport. Sports provide a unique and innovative approach to reaching students in a friendly atmosphere while learning concepts usually to abstract for them to grasp due to their limited experience and exposure.

Another unique feature of this project is the focus on middle schools science and mathematics. It responds to a dearth of attention to this level in public schools and fills a gap in

the relevant literature. Middle school students often experience a drop in grades due to lack of organizational skills and difficulty adjusting to the requirements of several teachers. Learning science and mathematics principles through participating in sports will help students through this transition phase and will reduce the chances of "falling through the cracks".

The project is also targeting students who have participated at the elementary school level in *Sisters in Science*. The middle schools chosen are the elementary school feeder schools. This program will be allow the students to continue in an intervention program aimed at helping them succeed in science and mathematics. It will also allow the researchers to longitudinally track girls who participated in *Sisters in Science* and then continue to participate in the SISS program creating a second level intervention or double treatment.

References

American Association of University Women. (1998). *Gender Gaps: Where schools still fail our children.* Washington, DC: Author.

Apple, M.W. (1992). Do the standards go far enough? Power. Policy and practice in mathematics education. *Journal for Research in Mathematics Education. 23*, 412-431.

Baker, P. (1997, July 26). Clinton takes governors to ask over education: Bypassing statehouses, Present signs up 15 major cities for student testing plan. *The Washington Post*, A9.

Culotta, E. (1990). Can science education be saved? *Science*, 250 (49986). 1327-1330.

Gardner, H. (1993). *Multiple intelligences: The theory in practice.* New York: Basic Books.

Hammrich, P. (1997). Yes daughter you can: Empowering parents is the first step toward improving females' achievement in science. *Science and Children, 34*(4), 21-24.

Hanson, S.L. (1996). *Lost talent: Women in the sciences.* Philadelphia, PA: Temple University Press.

Kozol, J. (1991). *Savage inequalities: Children in America's schools.* New York: Crown Publishers, Inc.

Malcolm, S. M. (1997). *Girls succeeding in science, mathematics and technology: Who works and what works.* American Association of University Women Conference Proceedings, 1997, Philadelphia, PA.

Nieto, S. (1996). *Affirming diversity: The sociopolitical context of multicultural education.* (2nd ed.). New York: Longman.

Oakes, J. (1990). *Lost talent: The underparticipation of women, minorities, and disabled persons in science.* Santa Monica: Rand.

Theberg, C.L. (1993, April). *The boys all scramble through: Some gender issues in science making conversations.* National Science Foundation. Presented at the annual meeting of the American Educational Research Association, Atlanta, GA.

Tate, W.F. (1994). Race, retrenchment, and reform of school mathematics. *Phi Delta Kappan, 75*(6), 477-484.

Vinovski, M.A. (1996). An analysis of the concept and uses of systemic educational reform. *American Educational Research Journal, 33* (1), 53-85.